Electricity providers are bombarded with challenges in maintaining grid stability and keeping the power supply consistent. Peak-load variability is on the rise, and once common solutions such as building more fossil fuel-fired peaking plants are no longer defaults for solving energy issues. Renewable energy sources introduce another challenge: balancing intermittency.

The smart grid’s improved controls architecture and insight have ushered in alternatives for more dynamic energy management. These advancements have allowed utilities to increasingly leverage demanding resources for maintaining grid reliability. They have provided more opportunities to do so in a precise, mutually beneficial manner for all parties.

A new demand-side paradigm exists. More utilities in the U.S. and across the globe are offering commercial, retail, institutional and industrial customers the option to join automated demand response (auto DR) programs. Auto DR programs automate a facility’s response to energy prices and reliability signals so it can plan to reduce load during peak periods to trim costs and reduce grid strain. The programs provide direct, effective access to customers who use substantial amounts of electricity yet have been difficult to reach for load-balancing efforts. It also is one of the most cost-effective ways to meet demands.

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AUTOMATED BENEFITS

Auto DR programs add value to traditional DR efforts, which require manual involvement from customers to reduce specific energy loads during a DR event when demand peaks and exceeds supply. With these manual efforts, utilities typically call or email customers before events to request they shed load at a given time.

Auto DR programs are changing this load-shed equation and driving deeper, more successful results—the effects of the programs’ repeatable, scalable and flexible load-reduction capabilities. These programs connect utilities with commercial and industrial customers—a customer segment with plentiful load-reduction potential, especially from an aggregation standpoint. This segment typically has the capacity to meet utilities’ energy-shed needs—particularly when utilities need the additional capacity—and they can do so without negatively impacting business operations if they have enough notice. Commercial and industrial customers typically boast some of the foundational infrastructure on which utilities can build easily to further the critical, direct link with the facilities at the facility-equipment level.

Using automated load-reduction technologies, auto DR programs remove the manual involvement required of customers, ensuring optimal, accurate, load-reduction measures occur in response to utility pricing signals. This flexible, open technology is paving the way for accessing hard-to-reach commercial and industrial customers, but it also is applicable to other customers, including residential and small commercial ones.

Auto DR programs help participants save money or allow them better tariffs to take advantage of peak pricing periods. For utilities, auto DR benefits are numerous. Utilities gain direct insight into available customer loads during peak periods and a direct link to shed available loads in a precise, near-immediate way.

In addition to improving grid stability, auto DR programs can help utilities reduce carbon emissions by avoiding bringing idling peaking plants online. Shedding load instead of buying expensive power on the spot market saves money for utilities and their customers.

As states begin to issue regulatory goals, auto DR programs are meeting aggressive mandates, specifically renewable energy goals. In California, for example, 33 percent of public utilities’ electric generation must come from renewable energy sources by 2020. As California works to meet this mandate and other states pursue similar goals, auto DR can help address accommodating peak variability changes produced by renewable generation, including solar and wind, to maintain grid reliability and balance intermittency.

CONTROLS ARCHITECTURAL FOUNDATIONS

Smart grid standards have encouraged widespread adoption and applicability of auto DR programs. OpenADR 1.0 was developed in 2002 as part of a joint effort by California and the Demand Response Research Center to form the basis of an open communications specification to automate DR. The National Institute of Standards and Technology (NIST) identified OpenADR 1.0 as a key specification for smart grid communications, which led to OpenADR 2.0.

Smart grid technology based on OpenADR 1.0 is interoperable and vendor-neutral, quelling concerns of stranded assets and future-proofing technology investments by auto DR program participants. This also provides a way for utilities to use auto DR software to send price and reliability signals over the Internet to participating customers using set OpenADR messages.

These efforts led to the formation of the OpenADR Alliance, a group of utilities, companies and institutions including the Lawrence Berkeley National Laboratory, Southern California Edison, EnerNOC, Pacific Gas and Electric, Constellation Energy, Hawaiian Electric Co. and Honeywell. The alliance fosters the development, adoption and compliance of OpenADR to ensure the technical
foundation for smart grid deployments using the specification, including auto DR programs.

Successful auto DR programs share characteristics that exemplify their potential. Programs based on the OpenADR 1.0 specification help establish the necessary communications gateway. From utilities’ standpoint, smart grid software based on open standards forms the critical linchpin to facilitating utility communications with participating customers to trigger the necessary load-shed measures.

Specifically, the DR automation server (DRAS) provides an open, secure path so utilities can send price and reliability signals over the Internet to an OpenADR client device at a facility. The client device interprets the signal and automatically triggers custom load-shedding measures via automated controls, increasing temperature set points, powering down manufacturing lines or shutting off banks of lights. This grid-to-customer equipment communication—a key smart grid component—enables rapid load reduction minus any manual involvement.

For commercial and industrial customers, meeting the necessary controls architectural requirements is the first step toward auto DR program participation. By having the right facility controls framework in place, these customers allow their building systems to listen for utilities’ pricing or event signals that indicate when to shed the load. When the signal comes through, the correct technology infrastructure receives the message and can initiate the correct, predefined load or customer situation reductions.

CALIFORNIA SAVINGS

Many facilities lack some of the building controls architecture that forms the backbone to facilitate this communication. As a result, in exchange for their auto DR program participation, many utilities provide for customers to receive low- or no-cost building system upgrades, expert implementation and engineering technical assistance—appealing incentives that help drive enrollment and facilitate necessary load-shed measures.

The arrangement has been successful for California public utilities looking to gain greater control over peak energy use. The utilities deployed critical-peak pricing or real-time pricing that would charge commercial and industrial customers more for electricity during peak periods, when the grid is stressed and when utilities call a DR event. The utilities use auto DR programs to support the pricing structures, programs that energy service providers across the region are helping implement. Auto DR programs help prevent power outages because of peaking demand, and they also keep costs lower by avoiding the need to build new generation.

Among customers involved in the Honeywell-managed auto DR efforts is Custom Building Products, a manufacturer of construction industry supplies. Because Custom Building Products is on time-of-use pricing, it needed a way to reduce energy loads during peak-demand events. Otherwise, its bill would increase...
substantially when rates rose. The company enrolled its 142,000-square-foot Bell, Calif., manufacturing facility in its utility’s auto DR program so it could respond automatically to DR events and receive utility bill credits and other incentives.

For its participation, Custom Building Products underwent a systematic, step-by-step process with Honeywell to assess the facility and ensure it was prepared to participate. Engineers studied the facility and installed the technology to enable the facility’s existing production control system to receive and respond to DR events. The utility uses the Akuacom DRAS based on OpenADR communication standards to interpret the DRAS pricing signals and automatically initiates pre-programmed, customer-scheduled load reductions in facility control systems. The smart grid software automatically triggers load-shedding event signals to the facility.

The upgrade included interfacing the facility’s industrial automation system to obtain electrical load shed during a scheduled event. This helped completely centralize all energy management within the facility so operators can monitor and control automated load reductions more easily from a central spot.

The companies developed and programmed load-reduction strategies based on a technical audit that examined energy-use patterns and control capabilities to determine where and when, given notice, the facility could cut energy use during DR events without negatively impacting operations. For example, Custom Building Products could shut down all but two manufacturing lines safely for short periods during an event and achieve adequate daily and monthly production requirements while maximizing energy cost savings.

Although the total project cost topped $80,000, the manufacturer offset a substantial amount of that total using utility incentives and support from a 2009 Department of Energy smart grid investment grant. It was one of several awarded from a smart grid-funding package under the American Recovery and Reinvestment Act. These funds lowered out-of-pocket expenses for the project to less than $3,000. Now Custom Building Products can shed more than 330 kW from its average 520-kW load during DR events. The manufacturer reaps substantial savings on its energy bill and helps the utility stabilize demand.

The audit and upgrade also uncovered savings opportunities beyond load-shed measures, which improved overall facility energy efficiency. System control helped generate an additional $6,000 in DR incentives and flattened demand peak. Some 70 percent of the facility was automated, and by centralizing facility energy management and control, Honeywell brought the remaining 30 percent online. All 21 production lines and secondary equipment, including air compressors and air pollution equipment, are tied to the control system, which helps the facility identify and address issues such as maintenance and commissioning needs more quickly.

By centralizing energy management within the facility to gain better visibility and control, Custom Building Products is better equipped to meet Air Quality Management District (AQMD) standards in Southern California. The facility also identified and corrected inefficiencies. The insight helped Custom Building Products realize its air compressors required additional commissioning; the compressors did not shut down completely when Custom Building Products switched off the production assembly. The facility had been spending a lot on unnecessary electricity.

**MODEL OF GRID STABILITY**

Automated load-reduction methods enabled by the smart grid help utilities realize greater and more precise load control. With energy service providers that can provide engineering implementation services and engage a large customer base with significant load-control potential, utilities can use auto DR programs to monitor when and how electricity is used to maintain a more stable electric grid.

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